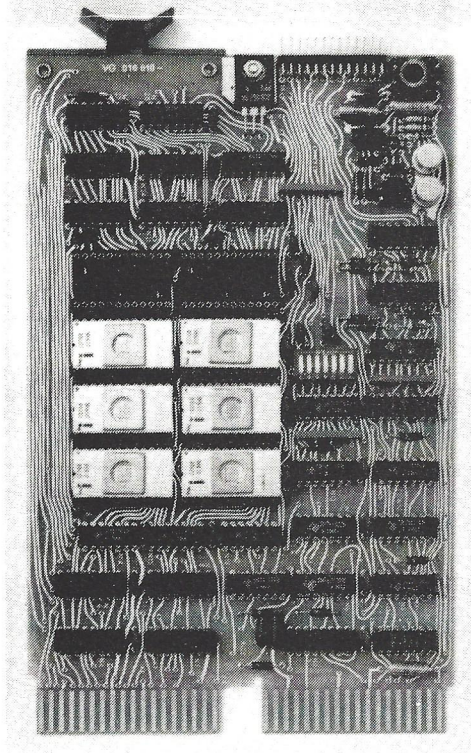


# VME11-A 4Kx16 EPROM MEMORY OPTION FOR LSI-11 MICROCOMPUTER



## FEATURES

- Sockets provided for installation of up to 4K words or 8K bytes of EPROM in 1K increments.
- EPROM address space can be customer configured via DIP-switches.
- Optional "1" data or "0" data for erased EPROMs.
- No special power requirements.
- Completely compatible with LSI-11 Bus protocol.
- Can be installed in any option location in LSI-11 and PDP11/03 systems.
- Built in provisions for "in machine programming" with the VMP11-A programming option.

## DESCRIPTION

The VME11-A is an LSI-11 memory option that contains eight sockets in which UV erasable, field programmable read-only memory (EPROM) integrated circuits of the 2708-type can be installed.

The VME11-A consists of a single "double height" (two sets of backplane pins) module that plugs into any standard LSI-11 backplane. The fully populated module contains 4096 by 16-bit erasable read-only memory.

EPROM contents are not volatile; programs and data stored in EPROMs are available whenever operating power is on. UV EPROMs can be erased by exposure to high-intensity ultra-violet light and then reprogrammed with new programs and data.

Switches are included on the VME11-A module to allow convenient selection of memory starting address and memory size. Addresses can be located in any 4K bank of system memory.

Built in provisions of the VME11-A allow for "in machine programming" using the VMP11-A programming option. Programming is straight forward and can be done using console ODT commands or by applying program control.

## 2708-TYPE 1Kx8 UV EPROM INTEGRATED CIRCUIT

The 2708-type is an ultra-violet light erasable, field programmable read-only memory that can be used for non-volatile storage of up to 1024 (1K) 8-bit bytes of programs and/or data. The EPROM is packaged in a standard 24-pin package and includes a transparent quartz cover over the integrated circuit chip. By exposing the chip to 2537Å UV light for approximately 10 to 30 minutes, stored data can be erased. The EPROM can then be reprogrammed with new contents.

The unprogrammed or erased EPROM contents are all "1's" (high state). Loading data into the EPROM introduces logic "0's" (low state). The VME11-A memory option is available in two configurations:

The VME11-AA module assigns "0's" (high state) to the LSI-11 data bus with unprogrammed or erased EPROM contents.

The VME11-AB module assigns "1's" (low state) to the LSI-11 data bus with unprogrammed or erased EPROM contents.

When installed on VME11-A memory modules, using the VMP11-A programmer, EPROMs may be loaded location after location or in small blocks of locations less than the 1K storage capacity.

## PROGRAMMING

Programming or loading of the EPROMs may be done the conventional way using commercially available programmers and PROM formatters.

More efficient and virtually error free programming is possible using the VMP11-A EPROM programmer which is an LSI-11 hardware option that greatly simplifies loading of EPROM chips. It allows the user to perform "in machine programming" of any portion of the EPROM either under program control or by using simple console ODT commands. This programmer contains its own ROM and RAM memory. Therefore it is not dependent of, or interfering with system memory even though it operates using the systems CPU.

Besides using this option for actual program loading of programs into EPROMs it may be used, if permanently installed, to generate nonvolatile data records of system events, to automatically generate gauge tables etc.

A number of commands of the VMP11-A option gives the user powerful tools for programming EPROMs:

PROGRAM data from any user defined system memory area to any user defined EPROM area.

COMPARE the source data with the loaded data.

DUMP desired data block on the console terminal.

ERASE-check for proper erasure of EPROMs.

VERIFY proper programming behavior of EPROMs.

## INSTALLATION

The VM11-A module can be installed in any LSI-11 bus-structured backplane. It requires only one option location and is not dependent on its position (device priority) along the bus. The module requires no special power, all operating power (+5V and +12V) is supplied by the normal power present on the backplane.

## SPECIFICATIONS

The following specifications and particulars are for informational purposes only and are subject to change without notice.

### ELECTRICAL

#### System Power

Without 2708-type EPROMs

+5V  $\pm$  5% 0,5A typ. (0,6A max.)

+12V  $\pm$  5% 0,15A typ. (0,2A max.)

With 2708-type EPROMs Installed (4K Capacity)

+5V  $\pm$  5% 0,55A typ. (0,7A max.)

+12V  $\pm$  5% 0,55A typ. (0,8A max.)

### ENVIRONMENTAL

Operating Temperature 0°C to 55°C

Storage Temperature Range -40°C to 66°C

Relative Humidity 10% to 95% non-condensing

### MECHANICAL

Height 13,2 cm (5,2 in)

Length 22,8 cm (8,9 in)

Width 1,27 cm (0,5 in)

## ORDERING INFORMATION

Part No.	Description
VM11-AA	4K UV EPROM memory module with "0" data if erased, unpopulated.
VM11-AA/1K	VM11-AA populated with 1K of 16-bit EPROM
VM11-AA/2K	" " " 2K " " "
VM11-AA/3K	" " " 3K " " "
VM11-AA/4K	" " " 4K " " "
VM11-AB	4K UV EPROM memory module with "1" data if erased, unpopulated.
VM11-AB/1K	VM11-AB populated with 1K of 16-bit EPROM
VM11-AB/2K	" " " 2K " " "
VM11-AB/3K	" " " 3K " " "
VM11-AB/4K	" " " 4K " " "
VMP11-AA	Programmer for VM11-A memories, allowing "in machine programming".

VME11-A LSI-11  
4K UV EPROM  
USER'S MANUAL

P R E L I M I N A R Y

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REMO VOGELANG, IM SOEMELE 513, FL-9496 BALZERS, FURSTENTUM LIECHTENSTEIN, TELEFON: 075 4 18 63

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## CONTENTS

### 1. INTRODUCTION

#### 1.1 INTRODUCTION

#### 1.2 GENERAL DESCRIPTION

#### 1.3 SPECIFICATIONS

##### 1.3.1 Electrical

##### 1.3.2 Environmental

##### 1.3.3 Mechanical

##### 1.3.4 Backplane Pin Utilization

##### 1.3.5 Ordering Information

### 2. INSTALLATION

#### 2.1 GENERAL

#### 2.2 CONFIGURING THE VM11-A MODULE

#### 2.3 2708-type EPROM HANDLING PRECAUTIONS

#### 2.4 INSTALLING THE VM11-A MODULE

### 3. USER NOTES

#### 3.1 GENERAL

#### 3.2 PROGRAMMING NOTES

#### 3.3 LOADING EPROMs

##### 3.3.1 General

##### 3.3.2 Data Word Format

##### 3.3.3 Addressing

#### 3.4 PROM FORMATTING USING FORMATTER PROGRAMS

#### 3.5 EPROM LOADING USING THE VMP11-A PROGRAMMER

##### 3.5.1 General

##### 3.5.2 Operation

#### 3.6 INSTALLING EPROMs

#### 3.7 ERASING EPROMs

## APPENDIX A: 2708-type 1Kx8 UV EPROM INTEGRATED CIRCUIT

## 1. INTRODUCTION

### 1.1 INTRODUCTION

The VMell-A (Figure 1-1) is an LSI-11 memory option that contains eight sockets in which ultra-violet (UV) erasable, programmable read-only memory (EPROM) integrated circuits can be installed. This manual contains user information required for installing the VMell-A 4K UV EPROM module, using 2708-type 1K by 8 UV EPROMs and operation of the VMP11-A programmer option.

### 1.2 GENERAL DESCRIPTION

The VMell-A consists of a single "double height" (two sets of backplane pins) module (printed circuit board) that plugs into any standard LSI-11 backplane. The fully populated module contains 4096 by 16-bit erasable read-only memory (EPROM). EPROM contents are not volatile; programs and data stored in EPROMs are available whenever operating power is on. UV EPROMs can be erased by exposure to high-intensity ultra-violet light and then reprogrammed with new programs and data. A clear quartz window over the EPROM chip allows the ultra-violet light to be directed onto the chip. Built in provisions allow for "in machine programming" using the VMP11-A programming option. Programming is straight forward and can be done using console ODT commands or applying program control.

#### Features:

- Sockets provided for installation of up to 4K words or 8K bytes of EPROM in 1K increments.
- EPROM address space can be customer configured via DIP-switches.
- Optional "1" data or "0" data for erased EPROMs.
- No special power is required. Only the normal +5 and +12Vdc operating voltages present on the LSI-11 backplane are required. An on-board inverter circuit provides the necessary -5V operating voltage to the EPROM array.
- Completely compatible with LSI-11 Bus protocol.
- Can be installed in any option location in LSI-11 and PDP-11/03 systems.
- Built in provisions for "in machine programming" with the VMP11-A programming option.

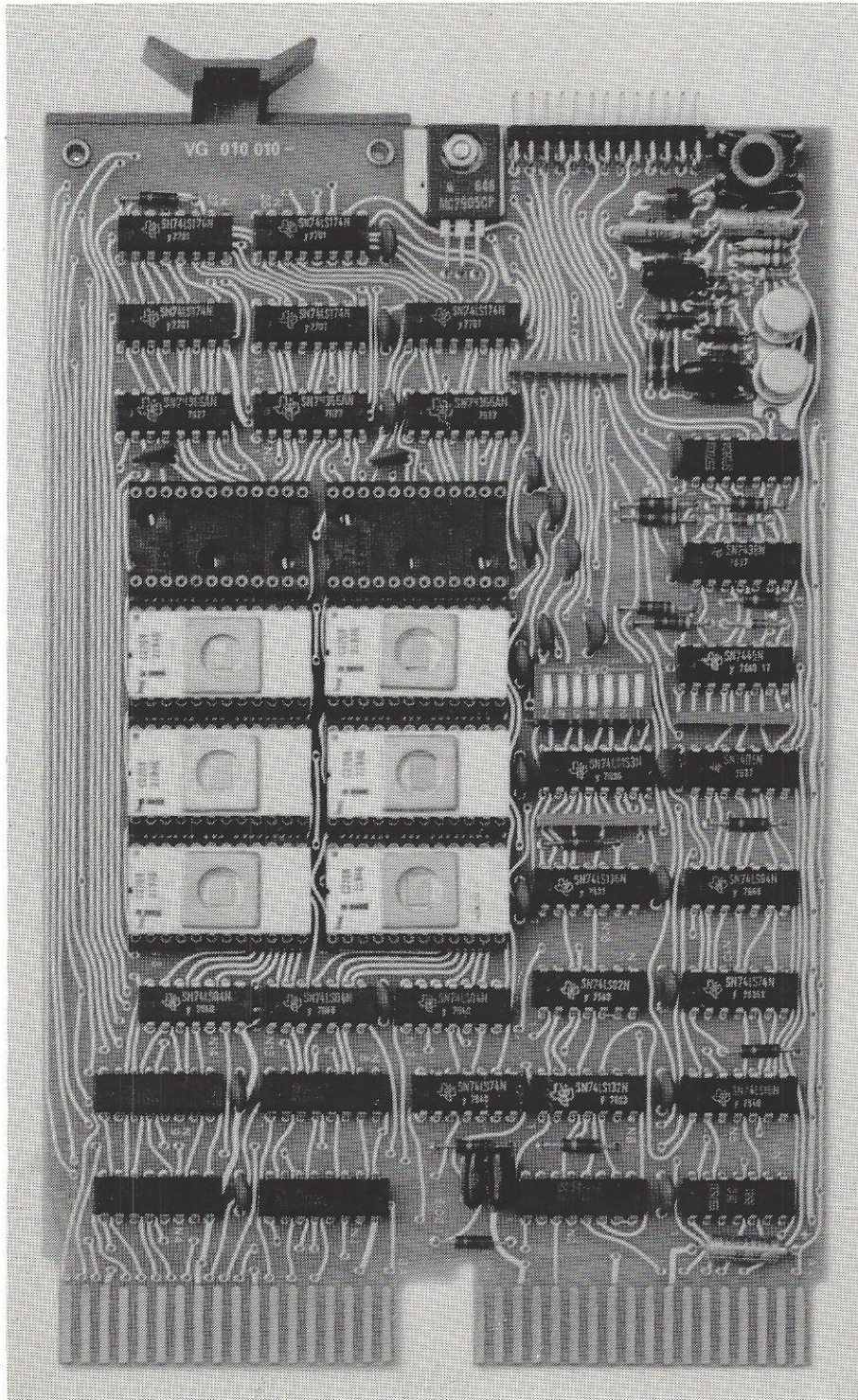


Figure 1-1 VMell-A 4K UV EPROM Module

## 1.3 SPECIFICATIONS

## 1.3.1 Electrical

## System Power

Less 2708-type EPROMs

+5V  $\pm$  5% 0,5 A typ. (0,6 A max.)+12V  $\pm$  5% 0,15 A typ. (0,2 A max.)

With 2708-type EPROMs Installed (4K Capacity)

+5V  $\pm$  5% 0,55 A typ. (0,7 A max.)+12V  $\pm$  5% 0,55 A typ. (0,8 A max.)

## 1.3.2 Environmental

## Operating Temperature

0°C to 55°C with a relative humidity of 10% to 95% (no condensation), with an adequate airflow across the module. When operating at the maximum temperature (55°C), air flow must maintain the inlet to outlet air temperature rise across the module to 7°C maximum.

## Storage Temperature Range

-40°C to 66°C.

## 1.3.3 Mechanical

## Size

Height	13,2 cm (5,2 in)
Length	22,8 cm (8,9 in)
Width	1,27 cm (0,5 in)

## 1.3.4 Backplane Pin Utilization

VME11-A backplane pin utilization is shown in Table 1-1.

## 1.3.5 Ordering Information

Part No.	Description
VME11-AA	4K UV EPROM memory module with "0" data if erased, unpopulated.
VME11-AA/1K	VME11-AA populated with 1K of 16-bit EPROM
VME11-AA/2K	" " " 2K " " "
VME11-AA/3K	" " " 3K " " "
VME11-AA/4K	" " " 4K " " "
VME11-AB	4K UV EPROM memory module with "1" data if erased, unpopulated.
VME11-AB/1K	VME11-AB populated with 1K of 16-bit EPROM
VME11-AB/2K	" " " 2K " " "
VME11-AB/3K	" " " 3K " " "
VME11-AB/4K	" " " 4K " " "
VMP11-AA	Programmer for VME11-A memories, allowing "in machine programming".

Table 1-1 VME11-A Backplane Pin Utilization

Module Side 1 (Component Side)		Module Side 2 (Solder Side)	
LSI-11 Bus Pin	Signal Mnemonic	LSI-11 Bus Pin	Signal Mnemonic
AA1		AA2	+5V
AB1		AB2	
AC1		AC2	GND
AD1		AD2	+12V
AE1		AE2	BDOUT L
AF1		AF2	BRPLY L
AH1		AH2	BDIN L
AJ1	GND	AJ2	BSYNC L
AK1		AK2	
AL1		AL2	
AM1	GND	AM2	BIAKI L
AN1		AN2	BIAKO L
AP1		AP2	
AR1		AR2	BDMGI L
AS1		AS2	BDMGO L
AT1	GND	AT2	BINIT L
AU1		AU2	BDAL0 L
AV1		AV2	BDAL1 L
BA1		BA2	+5V
BB1		BB2	
BC1		BC2	GND
BD1		BD2	
BE1		BE2	BDAL2 L
BF1		BF2	BDAL3 L
BH1		BH2	BDAL4 L
BJ1	GND	BJ2	BDAL5 L
BK1		BK2	BDAL6 L
BL1		BL2	BDAL7 L
BM1	GND	BM2	BDAL8 L
BN1		BN2	BDAL9 L
BP1		BP2	BDAL10 L
BR1		BR2	BDAL11 L
BS1		BS2	BDAL12 L
BT1	GND	BT2	BDAL13 L
BU1		BU2	BDAL14 L
BV1		BV2	BDAL15 L



## 2. INSTALLATION

### 2.1 GENERAL

This chapter contains the information required for configuring and installing the VMell-A module in an LSI-11 system back-plane, handling, and installing 2708-type EPROM integrated circuits. Configuring the module involves proper setting of switches that select EPROM addresses. Detailed information is included in the following paragraphs.

### 2.2 CONFIGURING THE VMell-A MODULE

Switch locations are included on the VMell-A module as shown in Figure 2-1. Switches allow selection of memory starting address and memory size.

Address selection switches allow EPROM addressing through a 32K address range.

#### NOTE

System memory must include memory location 000004. This location may be either read-only or read-write memory. The LSI-11 processor executes a dummy read bus cycle during the power up sequence using this address and requires a reply to complete the bus cycle. The actual memory contents read from the location are not used and can be any value.

EPROM addresses can be located in any 4K bank of system memory. The relationship between bus address bits, EPROM size and switch settings is shown in Figure 2-2. Set switches for a particular 4K bank as directed in Figure 2-2. Also set EPROM size switches S1 through S4 as shown in Figure 2-2; switches must be set to conform to EPROM size (in increments of 1K) to prevent erroneous addressing of unpopulated sockets.

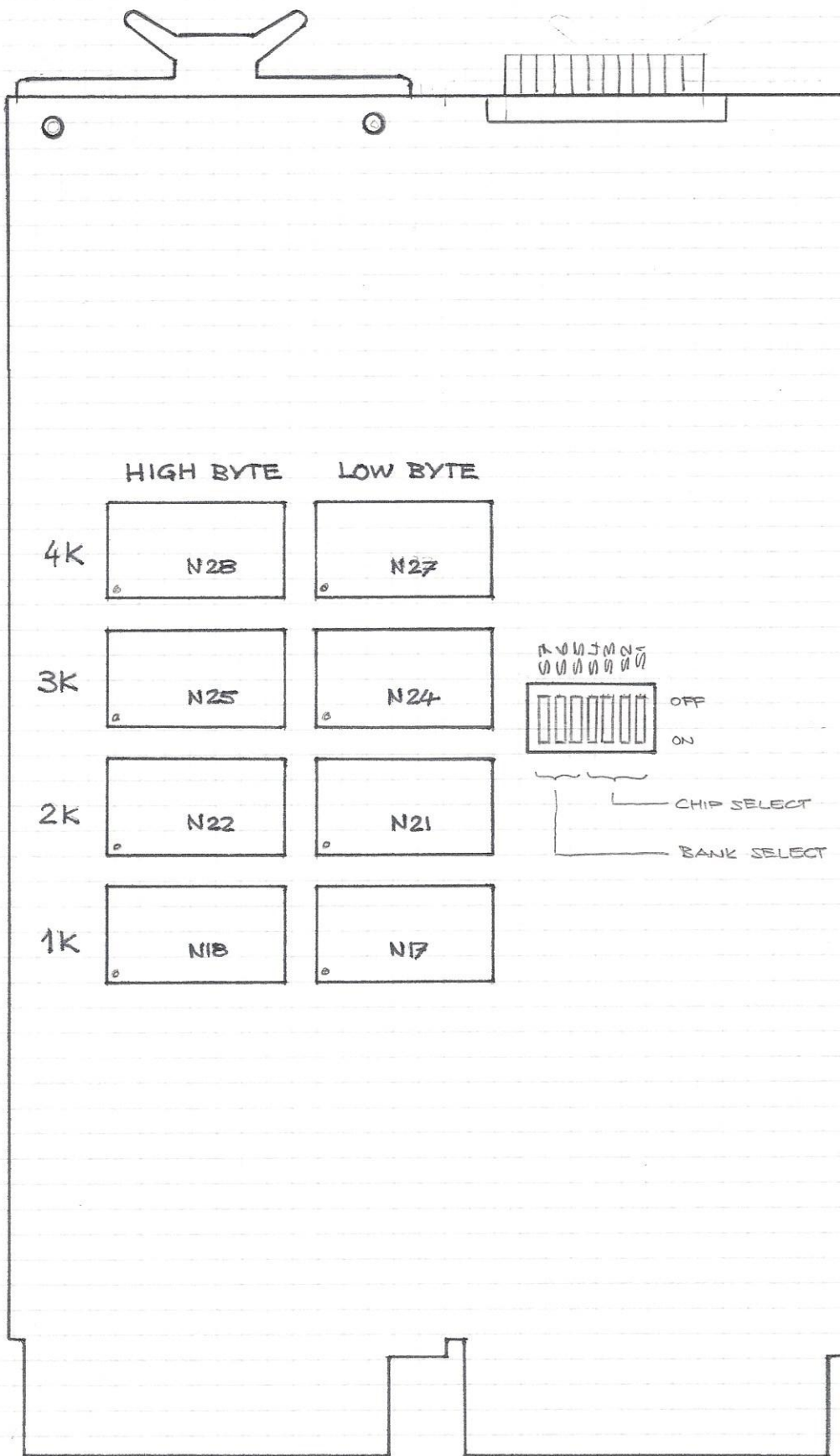
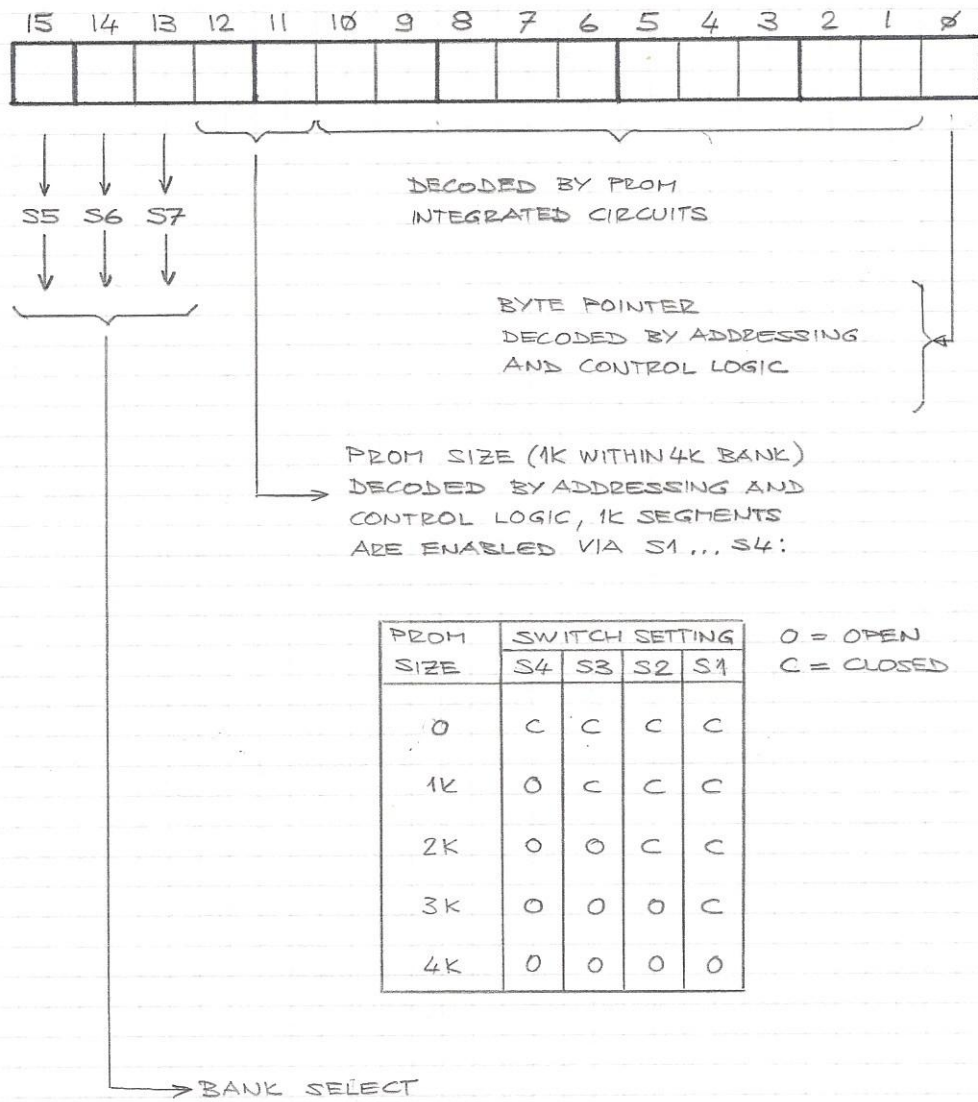


Figure 2-1 Switch and Socket Locations



ADDRESS RANGE (OCTAL)	SWITCH SETTING		
	S5	S6	S7
000000 - 017777	0	0	0
020000 - 037777	0	0	C
040000 - 057777	0	C	0
060000 - 077777	0	C	C
100000 - 117777	C	0	0
120000 - 137777	C	0	C
140000 - 157777	C	C	0
160000 - 177777	C	C	C

0 = OPEN  
C = CLOSED

Figure 2-2 VMell-A Addressing

### 2.3 2708-type EPROM HANDLING PRECAUTIONS

2708-type integrated circuit EPROMs are Metal Oxide Semiconductor (MOS) devices that can be damaged through improper handling. MOS devices can be easily damaged by static discharges due to their high input/output impedance. Safe installation requires that the conductive foam in which such chips are shipped be brought into physical and electrical contact with the VMell-A module or EPROM programming equipment prior to removing the EPROM from the foam. Unnecessary handling of EPROMs should be avoided once removed from the foam. When installed in VMell-A sockets, there is no danger of static discharge damaging the EPROMs.

Each 2708-type EPROM is implemented in a 24-pin integrated circuit package. Mechanical damage to the EPROMs can occur if they are carelessly handled. When installing EPROMs, insure that all pins are properly started into the socket before pressing the EPROM pins all the way into the socket.

### 2.4 INSTALLING THE VMell-A MODULE

The VMell-A module can be installed in any LSI-11 bus-structured backplane. It only requires one option location and is not dependent on position (device priority) along the bus. Hence, the module can be installed in any option location in single and multiple backplane systems. The module requires no special power; all operating power (+5V and +12V) is supplied by the normal power present on the backplane. The VMell-A normally should not be used in RXC11 floppy-disk based systems. Floppy disk software may attempt to write in EPROM locations resulting in bus timeout errors.

### 3. USER NOTES

#### 3.1 GENERAL

This chapter contains specific instructions for programming, loading, and erasing 2708-type EPROMs. Instructions are also included for using the VMP11-A programmer. The VMP11-A programmer allows "in machine loading" of the VM11-A memory option using ODT commands or under program control.

#### 3.2 PROGRAMMING NOTES

Generally, programs or data that can be read from read/write memory can also be read from PROMs. However, special care is required when using the MTPS-instruction and KEV11-option EIS instructions. These instructions are listed below:

MNEMONIC	OCTAL CODE	
MTPS	1064SS	Move byte to PS
MUL	070RSS	Multiply
DIV	071RSS	Divide
ASH	072RSS	Shift arithmetically
ASHC	073RSS	Arithmetic shift combined

These instructions, when executed on an LSI-11 processor (or PDP-11/03 system), fetch source operands via the DATIO bus cycle, rather than the DATI bus cycle. Hence, fetching a source operand from a PROM location will result in a bus error (time-out) because the processor will attempt to write into the addressed location after fetching the operand.

This potential problem can be avoided when writing the program by simply including a separate MOVE instruction. First, MOVE the source operand from the PROM location to a general register or a location in read/write memory. The MTPS or appropriate FIS installation is then executed using the general register and read/write memory location as the source operand.

Two examples are shown below using general register R4 and memory location TEMP as the source operand:

- Using a general register:
 

MOV NEWPS, R4;	move source operand from PROM to temporary (general) register.
MTPS R4;	move NEWPS to PS.
- Using a temporary read/write memory location:
 

MOV CONS, TEMP;	move source operand from PROM to temporary location in read/write memory.
MUL R1, TEMP;	multiply the contents of R1 by the CONSTANT in TEMP.

### 3.3 LOADING EPROMs

#### 3.3.1 General

Loading (blasting, burning, or programming) PROMs is the process where the binary information is stored in the PROM locations. This is a process that must be carefully executed as directed by the appropriate PROM manufacturer's instructions.

#### 3.3.2 Data Word Format

Each EPROM word, when read by the LSI-11 processor, is stored in two bytes in two separate EPROMs. Each word is simultaneously addressed and produces its respective 8-bit portion of the 16-bit word that is read. Since the word format is contained in two 8-bit bytes (one byte in each EPROM), the user must load each EPROM with successive memory locations, but dedicated to one 8-bit byte. This information can be generated manually - an error-prone, time-consuming process - or it can be generated automatically using appropriate ROM program software.

The unprogrammed (or erased) EPROM contents are all "1's" (high state). Loading data into the EPROM introduces logic "0's" (low state). The VMell-A memory is available in two configurations:

The VMell-AA (standard) module assigns "0's" (high state) to the LSI-11 data bus with unprogrammed (or erased) EPROM contents.

The VMell-AB (optional) module assigns "1's" (low state) to the LSI-11 data bus with unprogrammed (or erased) EPROM contents.

When installed on VMell-A memory modules, using the VMP11-A programmer, EPROMs may be loaded location after location or in small blocks of locations less than the 1K storage capacity.

#### 3.3.3 Addressing

EPROM integrated circuits, when installed in the VMell-AA and VMell-AB modules are addressed by high-active address bits. When loading EPROMs, the user must be careful that the correct addressing technique is used. A schematic of this addressing technique, relative to EPROM pins, is provided in Fig. 3-1. Note that LSI-11 bus address bit operations are 16-bit word bus transfers.

### 3.4 PROM FORMATTING USING FORMATTER PROGRAMS

A PROM formatter program (commercially available) reduces the work required for coding binary patterns for individual PROM chips. Input to such program is preferably in object tapes punched in absolute loader format. Such a program will produce and verify PROM tapes and listings for PROMs for use in the VMell-A.

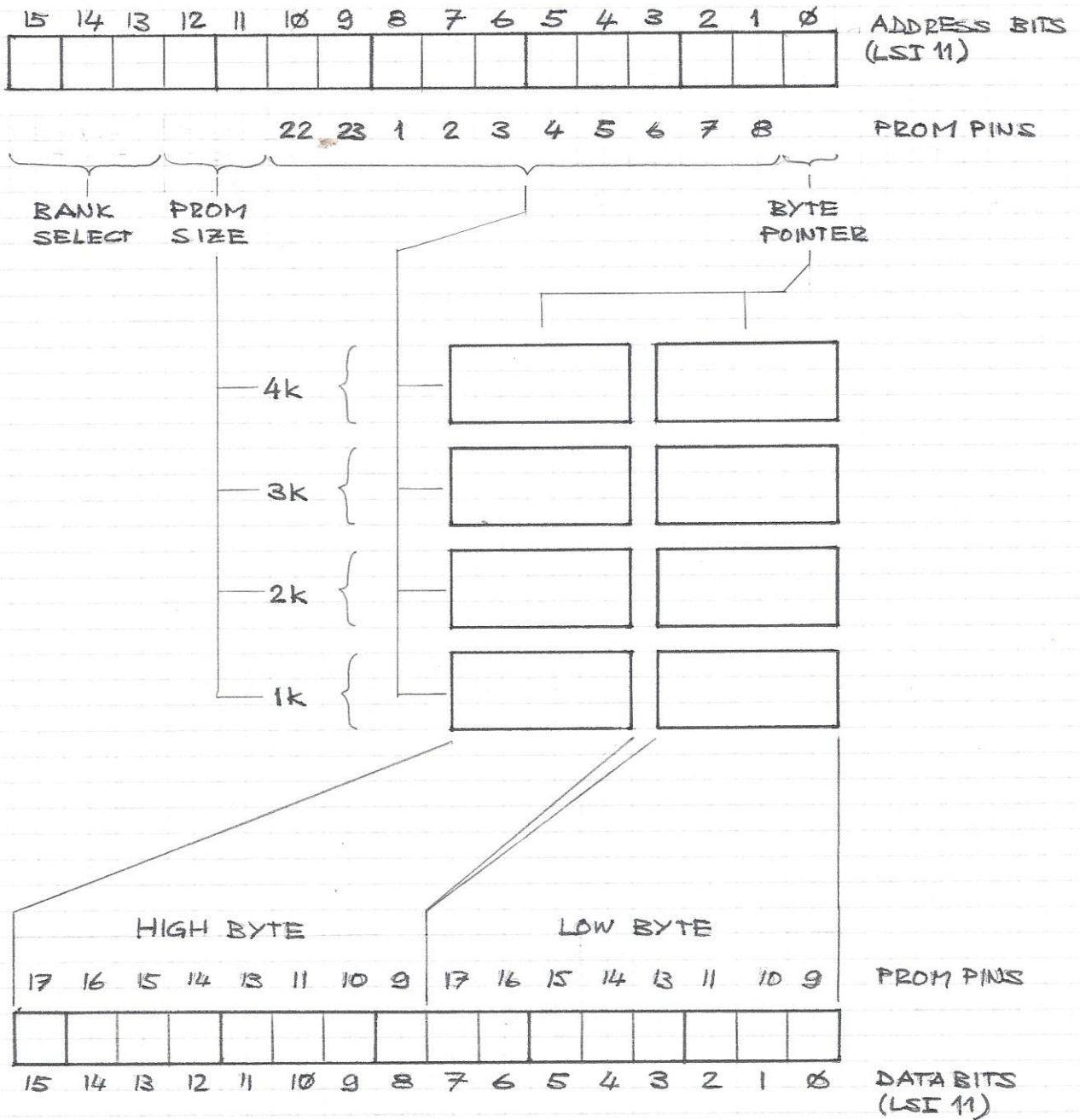


Figure 3-1 EPROM Addressing

### 3.5 EPROM LOADING USING THE VMP11-A PROGRAMMER

#### 3.5.1 General

The VMP11-A EPROM programmer is a hardware option that greatly simplifies loading of EPROM chips, since it allows the user to perform "in machine loading (or programming)" of any portion of the EPROM either under program control or by using simple console ODT commands. This programmer contains its own ROM and RAM memory (512 words address space). Therefore it is not dependent of or interfering with system memory even though it operates using the systems CPU. The only prerequisite of this option is the VM11-A memory module.

Besides using this option for actual program loading of programs into EPROMs it may be used, if permanently installed, to generate nonvolatile data records of system events, gauge tables etc.

#### 3.5.2 Operation

##### 3.5.2.1 General

Operation is possible under program control or by using simple console ODT commands. Data of any system memory area can be directly written (loaded) into a specified EPROM area. A scratch pad RAM area on the VMP11-A (224 words) is useful when manually loading EPROMs using console ODT commands.

##### 3.5.2.2 Commands

A list of the commands with their appropriate arguments is shown in Fig. 3-3. A command is to be entered into the General Register R0 and their arguments into the General Registers R1, R2, ...

##### Command Format

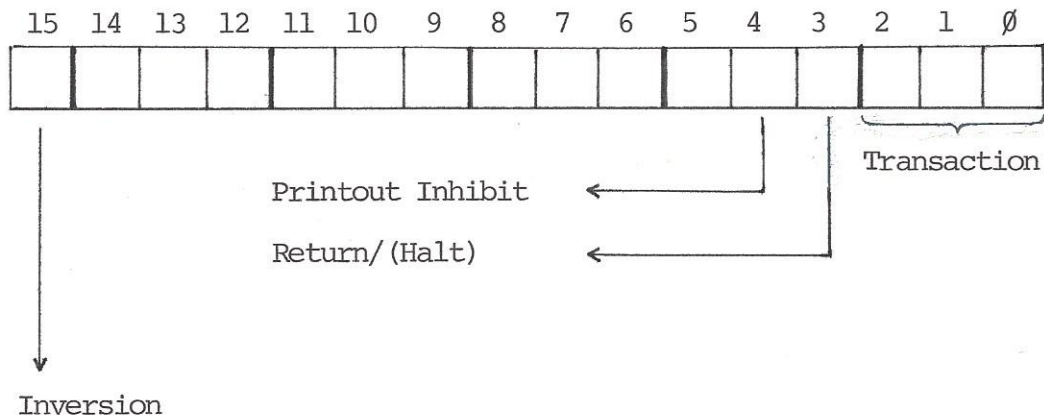


Fig. 3-2



Command Table

Transaction	R $\emptyset$			Registers for Arguments		
	Console ODT with Printout & HALT	Program Control with Printout & RETURN	Program Control without Printout & with RETURN	R1	R2	R3
NOP	$\emptyset\emptyset$	1 $\emptyset$	3 $\emptyset$	-	-	-
WRITE	$\emptyset$ 1	11	31	SA SOURCE	EA SOURCE	SA EPROM
COMPARE	$\emptyset$ 2	12	32	SA SOURCE	EA SOURCE	SA EPROM
DUMP	$\emptyset$ 3	13	33	SA	EA	
ERASED	$\emptyset$ 4	14	34	SA EPROM	EA EPROM	
TEST	$\emptyset$ 5	15	35	SA EPROM	EA EPROM	

SA = Start Address  
EA = End Address

Fig. 3-3

## List of commands

- NOP            No operation
- PROGRAM        The contents of the source data block specified by SA and EA is written (loaded or programmed) into the EPROM portion specified by its SA. The PROGRAM-command is automatically followed by a COMPARE-command.
- COMPARE        The contents of the source data block specified by SA and EA is compared against the contents of the EPROM portion specified by its SA. The contents of any location which do not match are listed on the console terminal with their appropriate addresses.
- DUMP            The contents of the data block specified by SA and EA are listed on the console terminal.
- ERASED         The contents of the data block specified by SA and EA is compared against " $\emptyset$ " (against "1" if the INVERSION bit is set). Any locations which are not properly erased are listed on the console terminal. This command is useful to check erased EPROMs prior to the loading.

- VERIFY All data bits of all locations of the EPROM data block specified by SA and EA are programmed for a fourth of the programming time specified for 2708-type EPROMs and checked thereafter. All locations not responding entirely are listed on the console terminal. TEST may be repeated. This command is useful to verify EPROMs for proper programming behavior prior to their usage.
- INVERT Any command may be operated with inversed data bits, if so specified in the command word.

### 3.5.2.3 Execution of the loading

The actual loading (or programming) of the EPROM is straightforward to the user:

- Set switch on VMP11-A to position LOAD.  
(This switch may continuously be left in the LOAD position. However to inhibit unintentional loading the switch may be set to the OFF position when not in a loading session.)
- Enter desired command into General Register R0.
- Enter arguments into General Registers R1 to R3.
- Start programmer at start address 161000 by means of ODT commands or under program control by a Jump to Subroutine (JSR PC). (Start address is dependent on address assignement of VMP11-A programmer, refer to Fig. 3-4.)
- When console printout is enabled, termination is indicated by printout "DONE" and then the programmer either halts or returns to the main program (RTS PC).

Note that the VMP11-A programmer automatically saves all General Register contents which are not used for command store and argument transfer. The Stack Pointer (R6) is also preserved. Furthermore it does not access any memory locations except its own and the locations specified by the user in a command.

VMP11-A Programmer  
Address Selection

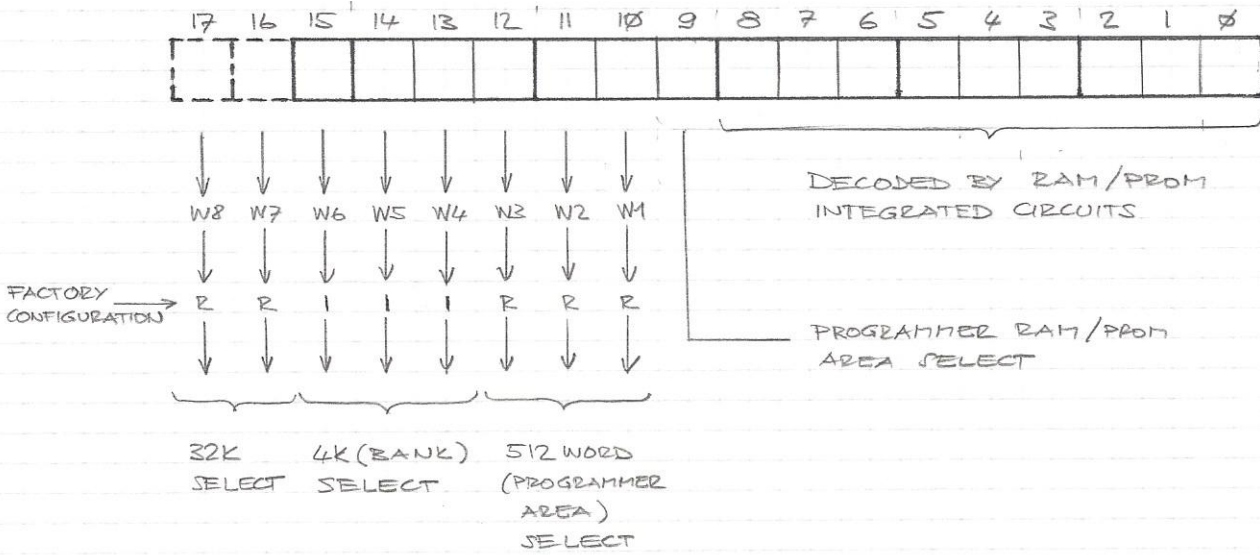


Fig. 3-4

## 3.5.2.4 Using console ODT with the VMP11-A programmer

```
Example 1: @ R0 / XXXXXX 1 <LF>
           -
           R1 / XXXXXX 20000 <LF>
           R2 / XXXXXX 27776 <LF>
           R3 / XXXXXX 60000 <CR>

           @ 161000G
           -
           DONE

           161002

           @
           -
```

---

The contents of the source block starting at octal 20000 and ending at 27776 is loaded into consecutive locations of the EPROM section starting at octal 60000.

---

### 3.6 INSTALLING EPROMs

EPROMs should be installed in the VM11-A sockets shown in Figure 2-1. EPROMs are normally installed starting with the first 1K locations (N17 and N18). Check EPROM size switch setting to insure that they agree with the number of EPROMs installed as shown in Figure 2-2. Also, be sure to install the low byte and high byte EPROMs in appropriate sockets.

When using the VMP11-A programming option, the EPROMs are installed before the programming takes place. Therefore errors in installing EPROMs are virtually eliminated.

### 3.7 ERASING EPROMs

EPROMs can be erased by exposure to ultra-violet light at a wavelength of  $2537\text{\AA}$ . The recommended integrated light (light intensity  $\times$  exposure time) is  $10 \text{ W-sec/cm}^2$ . The lamp is normally placed approximately 1 inch away from the EPROM to be erased and turned on for a period of time. The time required can be determined empirically or refer to typical times recommended by EPROM integrated circuit manufacturers. Typical times may vary from 10 to 30 minutes (approximately).

## A) 2708-type 1K X 8 UV EPROM INTEGRATED CIRCUIT

The 2708-type (Figure A-1) is an ultra-violet (UV) light erasable, field programmable read-only memory (PROM or EPROM) that can be used for non-volatile storage of up to 1024 (1K) 8-bit bytes of programs and/or data. The EPROM is packaged in a standard 24-pin package and includes a transparent quartz cover over the integrated circuit chip. By exposing the chip to 2537Å UV light for approximately 10 to 30 minutes, stored data can be erased. The PROM can then be reprogrammed (loaded) with new contents.

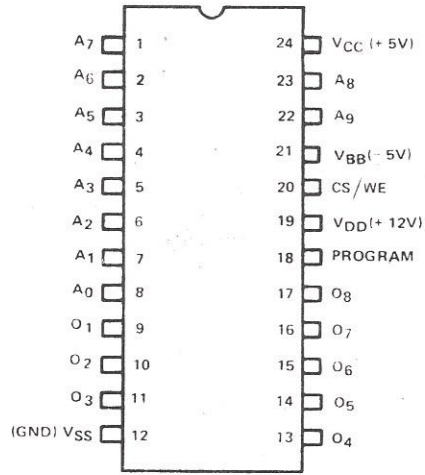
Operating power includes +5V, -5V, and +12V. Maximum access time is 450 nsec. Address and control inputs are TTL logic compatible. Output pins are three-state TTL logic signals. The third state is a high-impedance condition that effectively disconnects the chip's data output from output pins. This allows the use of a data bus shared by two or more similar devices.

The unprogrammed (or erased) EPROM contents are all "1's" (high state). Loading data into the EPROM introduces logic "0's" (low state). Note, that the VMell-A memory is available in two configurations:

The VMell-AA (standard) module assigns "0's" (high state) to the LSI-11 data bus with unprogrammed (or erased) EPROM contents.

The VMell-AB (optional) module assigns "1's" (low state) to the LSI-11 data bus with unprogrammed (or erased) EPROM contents.

When installed on VMell-A memory modules, using the VMP11-A programmer, EPROMs may be programmed (or loaded) location after location or in small blocks of locations less than the 1K storage capacity.



PIN NAMES

A <sub>1</sub> A <sub>9</sub>	ADDRESS INPUTS
O <sub>1</sub> O <sub>8</sub>	DATA OUTPUTS
CS/WE	CHIP SELECT/WRITE ENABLE INPUT

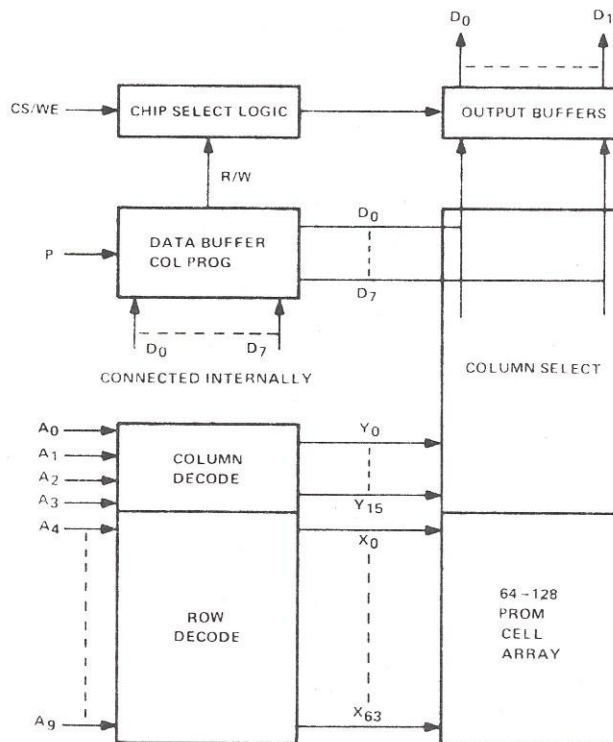


Fig. A-1 2708-type EPROM

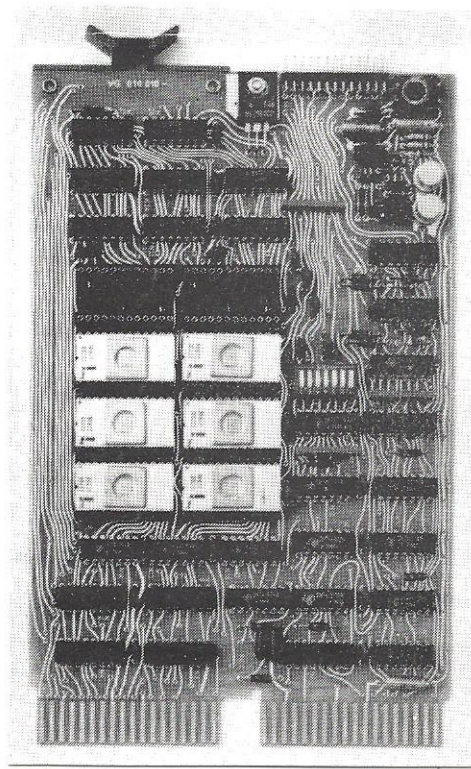


Figure 1-1 VMell-A 4K UV EPROM Module